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PAPERS ON INSECTS AFFECTING STORED PRODUCTS.

A LIST OF INSECTS AFFECTING
STORED CEREALS.
THE MEXICAN GRAIN BEETLE.
THE SIAMESE GRAIN BEETLE

BY

F. H. CHITTENDEN, :

In Charge of Truck Crop and Stored Product Insect Investigations.

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TRUCK CROP AND STORED PRODUCT INSECT INVESTIGATIONS.

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CONTENTS.

	Page.
List of insects affecting stored cereals	1
Introductory.....	1
Insects affecting stored cereals and cereal products.....	2
Cucujidæ.....	2
Dermestidæ.....	3
Other clavicorns.....	3
Bostrychidæ.....	4
Ptinidæ.....	4
Tenebrionidæ.....	4
Rhynchophora.....	5
Tineina.....	6
Phycitidæ.....	6
Other moths.....	7
Orthoptera.....	7
Neuropteroid insects.....	7
Acarina.....	7
10 Mexican grain beetle (<i>Pharaxonotha kirschi</i> Reitt.).....	8
Introductory.....	8
Description.....	9
The adult.....	9
The egg.....	9
The larva.....	10
The pupa.....	10
Literature.....	10
Observed habits.....	11
Enemies.....	12
Bibliographic references.....	13
10 Siamese grain beetle (<i>Lophocateres pusillus</i> Klug).....	14
Introductory.....	14
Description.....	15
The adult.....	15
The larva.....	16
The pupa.....	17
Distribution.....	17
Habits.....	17
Bibliography.....	18

ILLUSTRATIONS.

	Page.
1. 1. The Mexican grain beetle (<i>Pharaxonotha kirschi</i>): Adult, larva, pupa, details	8
2. The Siamese grain beetle (<i>Lophocateres pusillus</i>): Adult, larva, pupa, details	14

PAPERS ON INSECTS AFFECTING STORED PRODUCTS.

A LIST OF INSECTS AFFECTING STORED CEREALS.

By F. H. CHITTENDEN, Sc. D.,

In Charge of Truck Crop and Stored Product Insect Investigations.

INTRODUCTORY.

Lists of the insects that attack various cultivated crops are being published from time to time and republished with additional names until we have, of the various species that affect certain crops, some very complete lists. A notable example is the late Dr. J. A. Lintner's list of injurious apple-tree insects, which numbers 356 species.^a A preliminary list published by the same writer in 1882 contained only 176 species, less than half the number known to affect the apple 14 years later. Similar lists, more or less incomplete, but furnishing a basis for future additions, have been published of insects that affect the strawberry, the grapevine, the blackberry, the corn plant, the sugar beet, etc. Of many crops, however, there are no better published lists than those given in the catalogue of the exhibits in economic entomology at the World's Columbian Exposition issued in 1893 as Bulletin No. 31 (old series) of this bureau and in other similar exhibition catalogues (Bulletins 47, 48, and 53, new series) which have followed.

At the time the writer undertook the investigation of insects affecting stored products, which began with the inspection of cereal and other seeds exhibited at the World's Columbian Exposition at Chicago in 1893, his knowledge—in truth it might be said our knowledge—of these insects was confined to the species exhibited by this bureau at the exposition and catalogued in Bulletin No. 31 (old series). The list of the insects injuring stored corn numbered 20. Of these, two species, *Silvanus cassiæ* Reiche and *Dinoderus punctatus* Say, were incorrectly determined, and a third, *Calandra remotepunctata* Gyll., is a synonym, leaving only 17 species properly named.

In his first gropings for knowledge the writer was gravely informed by certain fellow entomologists of riper experience than himself that everything was well known, that nothing new would be found, and

^a LINTNER, J. A.—List of Injurious Apple-tree Insects. <11th Rep. Ins. N. Y. for 1895, pp. 263-272. 1896.

that the subject possessed no interest. In refutation of these statements it may be said that at the time they were made, in 1893, very little was positively known of the life histories of even our commonest granary insects and that the species themselves were not well known. Since that time many new forms have been added to our list, and many new facts concerning their habits, injuries, distribution, etc., have developed—all of sufficient interest to consume a considerable portion of the writer's time and energy now and perhaps for some years to come.

Inspection of the exhibits of cereal and other seeds at the World's Fair in Chicago, just mentioned, was the means by which many species, hitherto unknown or of little understood habits and distribution, became known, and notes made on their occurrence there and in other localities have added much to our knowledge concerning them. Visits during subsequent years, made by the writer and by agents and assistants, to flour mills, bakeries, and warehouses, and to feed and other stores have added much more to our already acquired information, and the correspondence of the bureau has contributed other facts.

The list which follows was prepared originally for the writer's personal use in the work of investigating insects of this class, but as the comprehensive work contemplated, on insects that affect stored cereals, will not be completed for some time, it has been thought advisable for the benefit of others working along similar lines to publish it now, in connection with and as an introduction to other papers which will follow:

INSECTS AFFECTING STORED CEREALS AND CEREAL PRODUCTS.

CUCUJIDÆ.

1. *Silvanus surinamensis* L. Chittenden: Farmers' Bul. 45, U. S. Dept.
Silvanus frumentarius Fab. Agr., p. 16, 1897.
Saw-toothed grain beetle. Infests all cereals, dried fruits, etc.
A general feeder.
2. *Silvanus bicornis* Er. Chittenden: Bul. 8, n. s., Div. Ent., U. S.
Dept. Agr., pp. 10-11, 1897.
Found in wheat granaries and dried figs.
3. *Silvanus mercator* Fauv. Bul. 8, n. s., Div. Ent. U. S. Dept. Agr.,
Merchant grain beetle. p. 12, 1897.
Habits similar to *S. surinamensis*.
4. *Cathartus gemellatus* Duv. Farmers' Bul. 45, U. S. Dept. Agr., p. 17,
Silvanus cassii auct. 1897.
Square-necked grain beetle. Infests corn and wheat.
5. *Cathartus advena* Waltl. Farmers' Bul. 45, U. S. Dept. Agr., p. 17,
Silvanus advena Waltl. 1897.
Foreign grain beetle. Attacks grain, meal, and flour; does not
develop to any extent in material kept
dry and clean.

6. *Læmophilæus minutus* Oliv.....Occurs commonly in cereals, but probably
Læmophilæus pusillus Sch. in the main predaceous and scavenging.
 Flat grain beetle.
7. *Læmophilæus ferrugineus* Steph.....Curtis: Farm Insects, p. 330, 1860.
 Rust-red grain beetle. Recorded to occur in granaries in Europe.
8. *Læmophilæus alternans* Er.....Bul. 2, o. s., Div. Ent., U. S. Dept. Agr.,
 p. 32, 1883.
 Infesting a mill. (This is probably an
 erroneous determination=*minutus*?)
9. *Læmotmetus rhizophagoides* Walk.Reitter: Harold's Coleop. Hefte, vol. 15,
Læmotmetus ferrugineus Gerst. p. 38, 1876.
Oryzæus cathartoides Reitt. Arrow: Ent. Mo. Mag., vol. 40, pp. 35-36,
 1904.
 Found in stored rice at Berlin, Germany.

DERMESTIDÆ.

10. *Attagenus piceus* Oliv.....Chittenden: Bul. 8, n. s., Div. Ent., U. S.
Attagenus megatoma Fab. Dept. Agr., pp. 15-19, 1897.
 Black carpet beetle. Lives on cereal and other seeds, and on
 woolen goods and other animal material.
11. *Anthrenus verbasci* L.....Bul. 8, n. s., Div. Ent., U. S. Dept. Agr.,
Anthrenus varius L. p. 22, 1897.
 Small cabinet beetle. Attacks wheat, flour, etc. A cabinet pest.
12. *Trogoderma tarsale* Melsh.....Bul. 8, n. s., Div. Ent., U. S. Dept. Agr.,
 Larger cabinet beetle. pp. 19-21, 1897.
 Attacks wheat, seeds, nuts, and animal sub-
 stances in store. It is also a cabinet
 pest.
13. *Trogoderma ornatum* Say.....Kellicott: Proc. Columbus Hort. Soc., vol.
 Ornate cabinet beetle. 9, p. 12, 1894.
 Living on pop corn.
14. *Æthriostoma undulata* Motsch.....Cotes: Indian Museum Notes, vol. 3, p. 119,
 1894.
 Destructive to wheat.

OTHER CLAVICORNÆ.

15. *Tenebroides mauritanicus* L.....Farmers' Bul. 45, U. S. Dept. Agr., p. 18,
Trogosita mauritanica L. 1897.
 Cadelle. In various cereal and other seeds.
16. *Lophocateres pusillus* Klug.....Chittenden: Insect Life, Div. Ent., U. S.
Ostoma pusillum Klug. Dept. Agr., vol. 6, p. 219, 1894.
17. *Typhœa fumata* L.....Well known as occurring in stored products,
 but prefers decomposing material.
18. *Pharaxonotha kirschi* Reitt.....Chittenden: Insect Life, Div. Ent., U. S.
Thallisella conradti Gorb. Dept. Agr., vol. 7, p. 327, 1895.
 Mexican grain beetle. In corn meal and edible tubers.
19. *Carpophilus dimidiatus* Fab.....Chittenden: Insect Life, Div. Ent., U. S.
 Dept. Agr., vol. 6, p. 219, 1894.
 Breeds in corn meal.
- 19a. *Carpophilus pallipennis* Say.....Weed, H. E.: Bul. 17, Miss. Agr. Exp. Sta.,
 Corn sap-beetle. p. 9, 1891.
 Found in corn throughout the winter when
 stored.

BOSTRYCHIDÆ.

20. *Dinoderus truncatus* Horn.....(Chittenden: Insect Life, Div. Ent., U. S. Dept. Agr., vol. 7, p. 327, 1895.
Larger grain borer. Breeds in corn and edible tubers.
21. *Rhizopertha dominica* Fab.....Injurious to cereals in kernel; breeds in corn, rice, wheat, and in other hard substances containing starch.
Dinoderus dominica Fab.
Dinoderus pusillus Fab.
Rhizopertha pusilla Fab.
Lesser grain borer.

PTINIDÆ.

22. *Ptinus fur* L.....Bul. 4, n. s., Div. Ent., U. S. Dept. Agr., p. 127, 1899.
White-marked spider beetle. Injurious to flour, crackers, seeds, etc.
23. *Ptinus brunneus* Duft.....Occurs in same situations as the above, and as its habits are practically identical it probably feeds also on cereals.
24. *Niptus hololeucus* Fald.....Fitch (Powers): The Entomologist, vol. 12, p. 46, 1879.
In "corn meal;" common in granaries in Europe.
25. *Gibbium psylloides* Czern.....Schwarz (unpublished).
Gibbium scotias Fab. In stale bread in a bakery at Washington, D. C.; in storehouses, etc.
26. *Sitodrepa panicea* L.....Bul. 4, n. s., Div. Ent., U. S. Dept. Agr., pp. 124-126, 1899.
Anobium paniceum L. A general feeder.
Drug-store beetle.
27. *Lasioderma serricorne* Fab.....Bul. 4, n. s., Div. Ent., U. S. Dept. Agr., p. 126, 1899.
Lasioderma testaceum Duft. Habits similar to above; observed to breed in rice, yeast cakes, fish food, etc.
Cigarette beetle.
28. *Catorama punctulata* Lec.....Quaintance: Bul. 36, Fla. Agr. Exp. Sta., pp. 381-382, 1896.
In corn, corn meal, flour, etc.
29. *Catorama zeæ* Waterh.....Trans. Ent. Soc. London, vol. 5, Proceedings, p. lxviii, 1847-1849.
Tricorynus zeæ Waterh. "Attacking the grain of the common maize."

TENEBRIONIDÆ.

30. *Tenebrio molitor* L.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 14-15, 1897.
Yellow mealworm. Injurious to ground cereals, especially when stale.
31. *Tenebrio obscurus* Fab.....Farmers' Bul. 45, U. S. Dept. Agr., p. 15, 1897.
Dark mealworm. Infests ground cereals.
32. *Tenebrio tenebrioides* Beauv.....Unpublished.
33. *Tribolium confusum* Duv.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 11-12, 1897.
Tribolium ferrugineum auct. Confused flour beetle. A general feeder, injurious to cereals in every form.

34. *Tribolium navale* Fab.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 12-13, 1897.
Tribolium ferrugineum Fab. Habits like preceding.
 Rust-red flour beetle.
35. *Tribolium madens* Charp.....Johnson: Amer. Miller, Jan. 1, 1896, p. 32.
 Black flour beetle. Habits similar to two preceding.
36. *Gnathocerus cornutus* Fab.....Farmers' Bul. 45, U. S. Dept. Agr., p. 13, 1897.
Echocerus cornutus Fab. Infests ground cereals.
 Broad-horned flour beetle.
37. *Gnathocerus (Echocerus) maxillosus* Fab.....Farmers' Bul. 45, U. S. Dept. Agr., p. 13, 1897.
 Slender-horned flour beetle. Infests corn and corn meal.
38. *Cænocorse ratzeburgi* Wissm.....Farmers' Bul. 45, U. S. Dept. Agr., p. 13, 1897.
Palorus ratzeburgi Wissm. Infests cereals, whole and ground.
 Small-eyed flour beetle.
39. *Cænocorse subdepressa* Woll.....Chittenden: Ent. News, vol. 7, p. 138, 1896.
Palorus subdepressus Woll. Lives in granaries in Europe and South America and in cereals in the United States.
 Depressed flour beetle.
40. *Latheticus oryzae* Waterh.....Waterhouse: Ann. & Mag. Nat. Hist., vol. 5, pp. 147-148, Feb., 1880.
Lyphia striolatus Fairm. Breeds in rice, wheat, and barley.
 Short-horned flour beetle.
41. *Sitophagus solieri* Muls.
Sitophagus hololeptoides Lap.
42. *Alphitobius diaperinus* Panz.....Food habits similar to those of *Tenebrio*;
 Lesser mealworm. prefers spoiled material.
43. *Alphitobius piceus* Oliv.....There are brief notes on occurrence in grain.
44. *Alphitophagus bifasciatus* Say.....Commonly occurs in spoiled cereals, but
Phylethus bifasciatus Say. does not injure sound material.
Alphitophagus 4-pustulatus Steph.

RHYNCHOPHORA.

45. *Calandra granaria* L.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 4-5, 1897.
Sitophilus granarius L. Breeds in all cereals in the kernel, except, perhaps, oats and unhulled rice, and in some prepared cereals, etc.
Calandra remotepunctata Gyll.
 Granary weevil.
46. *Calandra oryzae* L.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 5-6, 1897.
Sitophilus oryzae L. Infests all cereals in kernel.
 Rice weevil.
47. *Caulophilus latinasus* Say.....Chittenden: Tech. Ser. 4, Div. Ent., U. S. Dept. Agr., pp. 29-30, 1896.
 Broad-nosed grain weevil. In corn, chick-peas, ginger, etc.
48. *Brachytarsus alternatus* Say.....Quaintance: Bul. 36, Fla. Agr. Exp. Sta., pp. 380-381, 1896.
 Larva and adult injurious to stored corn, cowpeas, and "English peas."
49. *Brachytarsus variegatus* Say.....Lintner: 2d Rep. Ins. N. Y., pp. 139-141, 1885.
 Adult exceptionally eats kernels of wheat in bin.

50. *Rhyncolus oryzae* Gyll.....Schönherr: Genera et Species Curculionidum, p. 1075, 1837.
Described from specimens found between grains of rice in store at Stockholm.

TINEINA.

51. *Sitotroga cerealella* Oliv.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 6-7,
Gelechia cerealella Oliv. 1897.
Angoumois grain moth. Infests all cereals in kernel.
52. *Tinea granella* L.....Farmers' Bul. 45, U. S. Dept. Agr., p. 7,
1897; also Bull. 8, n. s., Div. Ent., U. S.
Dept. Agr., pp. 31-35, 1897.
European grain moth.
53. *Tinea biselliella* Hum.....Chittenden: Tech. Ser. 4, Div. Ent., U. S.
Dept. Agr., p. 30, 1896.
Reared from stored wheat and corn, but doubtful if it breeds in cereals.
54. *Tinea pallescentella* Haw.....Stainton: Entomologist's Annual, 1857, p. 122.
"The larva is granivorous."
55. *Tinea misella* Zell.....Gregson: Entomologist's Annual, 1857, p. 121.
Reared "from unthrashed wheat."
56. *Batrachedra rileyi* Wals.....Chittenden: Bul. 8, n. s., Div. Ent., U. S.
Dept. Agr., pp. 32-33, 1897.
Attacks corn in field and said to live in it in store.
57. *Acompsia pseudosporetella* Stain.....Gregson: See Butler's "Our Household Insects," p. 106, 1896.
Ecophora pseudosporetella Stain.
Injurious to rice, brooms, seeds, etc.

PHYCITIDE.

58. *Plodia interpunctella* Hübn.....Farmers' Bul. 45, U. S. Dept. Agr., pp. 9-10, 1897.
Ephestia zea Fitch.
Indian-meal moth. Attacks all cereals; a general feeder.
59. *Ephestia kuehniella* Zell.....Chittenden: Cir. 112, Bur. Ent., U. S.
Dept. Agr., 1910.
Mediterranean flour moth
Infests all cereals, but most injurious to flour.
60. *Ephestia cautella* Walk.....Chittenden: Bul. 8, n. s., Div. Ent.,
U. S. Dept. Agr., p. 7, 1897.
Ephestia cahiritella Zell.
Ephestia passulella Barr. Reared from corn meal, dried fruits, seeds, nuts, etc.
Fig moth.
61. *Ephestia ficulella* Barr.....Insect Life, Div. Ent., U. S. Dept. Agr.,
vol. 5, pp. 141, 350, 1893; Chittenden:
Bul. 8, n. s., Div. Ent., U. S. Dept. Agr., 1897.
In oatmeal at Kingston, Jamaica; recorded also from Galveston, Tex.
62. *Ephestia elutella* Hübn.....Bul. 8, n. s., Div. Ent., U. S. Dept. Agr.,
p. 9, 1897.

OTHER MOTHS.

63. *Pyralis farinalis* L.....Farmers' Bul. 45, U. S. Dept. Agr., pp.
Asopia farinalis L. 10-11, 1897.
 Meal snout-moth. Attacks cereals, hay, etc., but not known
 to injure material that is kept quite
 clean and dry.
64. *Melissoblaptes gularis* Zell.....Jenner, J. H. A.: The Entomologist, vol.
 25, p. 286, 1892.
 In "polished Japan rice" in London.

ORTHOPTERA.

(Cockroaches.)

65. *Blatta orientalis* L.....Marlatt: Cir. 51, Bur. Ent., U. S. Dept.
Periplaneta orientalis L. Agr., pp. 8, 9, 1908.
Stylopyga orientalis L.
 Oriental cockroach.
66. *Blattella germanica* L.....Marlatt: Cir. 51, Bur. Ent., U. S. Dept.
Ectobia germanica L. Agr., pp. 9, 10, 1908.
Phyllodromia germanica L.
 German cockroach; croton bug.
67. *Panchlora surinamensis* L.....Insect Life, Div. Ent., U. S. Dept. Agr.,
 vol. 5, pp. 201, 268, 1893.
 Surinam roach.

NEUROPTEROID INSECTS.

(Thysanura, Isoptera, Corrodentia.)

68. *Lepisma saccharina* L.....Marlatt: Cir. 49, Bur. Ent., U. S. Dept.
 Silverfish. Agr., 1902.
69. *Lepisma domestica* Pack.....Marlatt: Cir. 49, Bur. Ent., U. S. Dept.
 Fire brat. Agr., 1902.
70. *Termes flavipes* Koll.....Marlatt: Cir. 50, Bur. Ent., U. S. Dept.
Philotermes flavipes Koll. Agr., 1908.
 White ant.
71. *Troctes divinatoria* Fab.....Marlatt: Bul. 4, n. s., Div. Ent., U. S. Dept.
Atropos divinatoria Fab. Agr., pp. 79-81, 1899.
 Book louse.
72. *Troctes corrodens* Heymons.....Heymons: Deutsch. ent. Zeitschr., 1909,
 pp. 452-455.

ACARINA.

(Mites.)

73. *Tyroglyphus farinæ* DeG.....Banks: Tech. Ser. 13, Bur. Ent., U. S.
Aleurobius farinæ DeG. Dept. Agr., p. 14, 1906.
 Flour mite.
74. *Tyroglyphus siro* Gerv.....Lintner: 3d Rep. Inj. Ins. N. Y., pp. 130,
 Cheese mite. 131, 1888.
75. *Tyroglyphus longior* Gerv.....Banks: Tech. Ser. 13, Bur. Ent., U. S.
 Elevator mite. Dept. Agr., p. 14, 1906.
 Insect Life, Div. Ent., U. S. Dept. Agr.,
 vol. 1, p. 51.
76. *Tyroglyphus americanus* Bks.....Banks: Tech. Ser. 13, Bur. Ent., U. S.
 Mill mite. Dept. Agr., p. 16, 1906.

THE MEXICAN GRAIN BEETLE.

(*Pharazonotha kirschi* Reitt.)

By F. H. CHITTENDEN, Sc. D.,

In Charge of Truck Crop and Stored Product Insect Investigations.

INTRODUCTORY.

Among grain-feeding insects which have not yet been permanently introduced into this country as pests, but which have come repeatedly under observation, is a clavicorn beetle, *Pharazonotha kirschi* Reitt. (fig. 1). This was one of the living species observed by the writer infesting stored grain in the foreign exhibits at the World's Columbian Exposition and was more abundantly distributed throughout these exhibits toward the end of the fall of 1893. At the time of its

discovery it was practically unknown to American scientists, with the exception of Dr. George H. Horn.

The Bureau of Entomology has also to record two reports of the occurrence of this species in stored corn in Mexico, one dated 1902 and the other 1910, as follows:

December 3, 1902, Mr. A. L. Herrera, of the City of Mexico, sent a sample of stored corn from Tlaxiaco, State of Oaxaca, infested with this and other species of in-

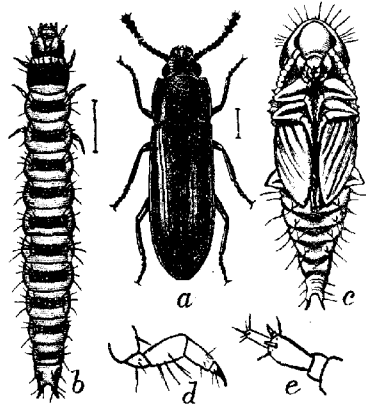


FIG. 1.—The Mexican grain beetle (*Pharazonotha kirschi*): a, Beetle; b, larva; c, pupa; d, leg of larva; e, antenna of larva. a, b, c, Much enlarged; d, e, more enlarged. (Original.)

sects which have been previously identified with injury of this nature in Central America.

During the winter of 1910 complaints were made through Mr. Ed. Los McCue, of the Cafetal Carlota Co., Oaxaca, of injury by weevils to corn, and on February 26 the specimens in question reached this office. Upon examination the principal injury proved to be due to the rice weevil (*Calandra oryza* L.), while the square-necked grain beetle (*Cathartus gemellatus* Duv.) and the Mexican grain beetle were also

present. No statement was made in regard to the habits of any species, but it was surmised by the correspondent that they all bored into the timbers of the crib. In this event it is probable that one of the grain borers (*Dinoderus truncatus* Horn) was present.

DESCRIPTION.

THE ADULT.

Before proceeding with a technical description of the insect it should be stated that the adult, or beetle, is about three-sixteenths of an inch in length, deep brown in color, and highly polished. It has been mistaken for a tenebrionid and has been compared with *Tribolium*, but it resembles the *Ulomini* only superficially and can be distinguished readily by its highly polished surface, by its longer antennæ, and by the five-jointed posterior tarsi.

This species was given the name which it now bears by Reitter in 1875,^{1a} a new genus being erected for its reception and placed by its describer near the genus *Antherophagus* in the family *Cryptophagidæ*. Afterwards it was removed to the *Erotylidæ*, and more recently it has been classified by the same writer¹⁰ as belonging to the *Cryptophagidæ* and the group *Cryptophagini*.

The genus *Pharaxonotha* is characterized by Reitter as follows:

Genus PHARAXONOTHA Reitt.

Antennæ stout, almost as in *Antherophagus*. Gular margin with a prominent tooth. Prosternum behind the coxæ subdilated, apex obtusely rounded, sides margined. Front biimpressed, prothorax hardly narrower than the elytra, subtransverse, sides entire, angles not thickened, basal and lateral margins slightly thickened, base on each side with an abbreviated and strongly impressed line. Elytra striate-punctate, striae entire and deeper toward apex, humeral angles acute and slightly prominent, anal abdominal segment subtuberculate at tip. Tarsi 5-jointed, fourth joint shorter and narrower than the preceding. Body elongate, robust, upper side hardly visibly pubescent.

The species is thus described by Reitter:

Pharaxonotha kirschi Reitt.

Oblong, slightly convex, subglabrous, fusco-castaneous, shining; head rather densely and rather deeply, and prothorax less densely punctate, subtransverse, almost truncate at apex, sides nearly straight, bisinuate at base, elytra finely striate-punctate, striae toward apex less deep, sutural stria posteriorly more impressed; beneath sparsely punctate, very finely and sparsely hairy.

Length, 4-4.5 mm.; width, 1.2-1.5 mm.

The beetle is illustrated in figure 1, a.

THE EGG.

The egg is somewhat variable in shape and size. It is more or less elongate-ellipsoidal in form and milk-white in color, and the surface is rather finely shagreened. The length varies from 0.94 to 0.99 mm. and the width from 0.35 mm. to 0.39 mm.

^a Numbers in superior type refer to corresponding numbers in the bibliographic list, page 13.

The other stages of this species were not described for lack of time when specimens were fresh and later these were not in condition for specific description.

THE LARVA.

The larva illustrated at *b* of figure 1 is elongate subcylindrical, about six times as long as wide. It is gray, each segment being darker at the middle, while at the sides of each of these darker spaces there are rather well developed piliferous tubercles. An enlarged leg is shown at *d* and an antenna, also enlarged, at *e*. When full grown the larva measures about five-sixteenths of an inch (8.5 mm.) in length.

THE PUPA.

The pupa (fig. 1, *c*) is about the same size as the adult, paler than the larva, nearly white. It will be noticed that the thorax bears conspicuous long hairs and that similar hairs project from tubercles on the abdomen. In the pupa as well as the larva the anal apex terminates in two divergent points.

It should be added that both larva and pupa are delicate and perceptibly softer than the common grain-feeding tenebrionids found in similar locations.

LITERATURE.

The literature on this species is decidedly scanty. The original description appeared in 1875.¹ This was followed by two records of the finding of the insect in cotton bolls from Bahia, Brazil, one in 1880,² when it is mentioned as "(4) one specimen of a *Diplocelus* not occurring in the United States," and again in 1885 as follows³: "(4) one specimen of a cryptophagid beetle, apparently undescribed and not occurring in the United States." Mr. E. A. Schwarz, who saw the specimen referred to, assures the writer that it is this species.

In the collection of the United States National Museum there are also specimens bearing this label: "In corn, Guatemala, March 24, 1884."

Brief mention was made in 1894⁵ of the occurrence of this species in exhibits of stored products, the insect being referred to as a "Cryptophagid (?)" with the statement that it was found living in corn meal and edible tubers from the Mexican and Guatemalan exhibits at the World's Fair held in Chicago in 1893. The following year⁶ this species was included in a list of foreign insects introduced into the United States in recent years. In 1896⁷ similar notes were published in a list of insects known to occur in stored products in Mexico and record was made of the capture of the species near San Antonio, Tex., in December, 1895.

In all, this species has received ten notices, none of them extensive, the remainder, which will not receive mention, being descriptive and synonymical articles and notes.

OBSERVED HABITS.

In order to obtain information in regard to the habits of the insect, a number of living adults was placed in a small rearing jar containing fresh meal and slices of raw potato, the latter to furnish additional moisture, and placed in a cool room. Here the adults showed conclusively that they were perfectly able to withstand the average temperature of an ordinary mill, warehouse, or granary of a latitude such as that of the District of Columbia. The beetles are much more active than the meal-feeding tenebrionids. When they were examined some were usually to be seen moving about on the meal and frequently they tried to climb the sides of the jar, although making little progress. Although they crawled into the meal for concealment, for warmth, or for oviposition, they do not, like *Tribolium*, burrow or excavate galleries. On the contrary, they form shallow pits or depressions, several beetles occupying the same pit in partial concealment. The eggs are deposited on the surface of the meal.

In one lot of insects of this species kept under observation, an equal number of *Tribolium* also lived and in perfect harmony. Neither species showed the least signs of being even in the slightest degree predaceous upon the other.

Even with limited material for observation, it soon became manifest that this grain beetle is quite capable of breeding freely in a moderately cool temperature. Beetles began pairing during the first week of April and daily during the warm weather following, but it was noticed that they had already deposited eggs at infrequent intervals during the winter, as a number of larvæ of varying sizes, observed in April, bore witness. The living imagos, seven of which remained alive in the first jar, were now removed to a different jar and placed by themselves. By this time, April 6, some of their progeny were about half-grown larvæ. Of these, the most mature transformed to pupæ May 1 and to imagos May 10, the remainder continuing as larvæ until considerably later.

From another lot of specimens segregated in a second rearing jar and kept in a warm room, it was found that from December 5 to April 10 one adult had issued and many pupæ were present. This gives a full life cycle of eighteen weeks, or four and one-half months, the dry artificial atmosphere probably accounting for the slowness of development.

It has always been noticed that when the larvæ are disturbed they have a habit of rolling up into a ball and remaining thus for a minute or more before resuming their usual activity.

When fully mature, larvæ were observed to come to the surface of the meal in the rearing jars to transform. Save for close observation, the true method of pupation might have escaped notice. When the contents of one jar became too dry, a bit of moistened blotting

paper was inserted. The excess of humidity caused by this addition induced uneasiness on the part of the larvæ, which were now full-grown. When, however, the normal degree of temperature was produced, the larvæ attacked the blotting paper, which happened to be placed against the glass, and soon constructed a pupal cell such as they probably produce under more normal conditions. One of these cells of about typical form is rounded irregularly and measures one-fourth of an inch in length by three-eighths of an inch in its widest diameter. The pupa, as in the case of the pupæ of so many other beetles, rests at the bottom of the cocoon on its back.

Larvæ selected during May for the purpose of observing the period of the pupal stage transformed to pupæ July 16 and to imagos July 22, or in between five and one-half and six days for different individuals. Others in a cooler temperature required 8, 9, and 10 days for the pupal period.

Under above conditions (e. g., from June 23 to July 25) the development of this species, from the laying of the egg to the issuance of the beetle, covered 32 days. This was during an exceedingly heated period and is doubtless not far from the minimum period for the life cycle. In another case, where the weather was cooler, comprising portions of the months of April, May, and June, the life cycle required 59 days, or eight and one-half weeks. Three distinct generations were obtained, from the first generation of beetles to their children and finally to the grandchildren.

The species does not appear to be long-lived under confined conditions. Adults, active and breeding, seldom lived longer than three months. Doubtless in the open this period can be greatly extended.

It should be mentioned in connection with the life history of this species that upward of a week is required for the beetle to acquire the full deep shining brown of maturity. The thorax and the apices of the elytra color last, and the latter often remain much lighter colored than the other parts. The beetles, however, are active long before they have acquired this complete coloration. Hence it happens that in most lots of the beetles seen there are many which are not fully colored, although otherwise perfect.

Some other experiments were made to ascertain if the insect is a primary feeder upon perfectly healthy dry seed. In hard wheat, corn, and beans a few larvæ hatched and for a time lived on the meal that the imagos cut from the corn, but failed to develop. In softer, fresher seed in the field they could no doubt breed freely.

ENEMIES.

A single natural enemy was observed in the rearing jars, viz, the predaceous mite *Pediculoides ventricosus* Newp. It occurred in April and May.

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THE SIAMESE GRAIN BEETLE.

(*Lophocateres pusillus* Klug.)

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INTRODUCTORY.

Among other species of injurious insects found for the first time in rice and other cereal exhibits, at the World's Columbian Exposition, held in Chicago in 1893, there was a small trogositid beetle, *Lophocateres pusillus* Klug, which occurred in exhibits from Siam, Liberia, and Ceylon, and which was new to the writer at that time. This species was not then included in our faunal lists, nor does the writer know of any record of its having become established in North America until about 1905⁸, although the French coleopterist M. A. Fauvel had

expressed the belief that the species might occur in North America. At the time of its discovery at Chicago it could not be ascertained whether this insect was predaceous or granivorous in habit. Nothing more was heard of the insect until ten years later (1903) when living specimens were observed during September in corn from Blanco, Peru, South America.

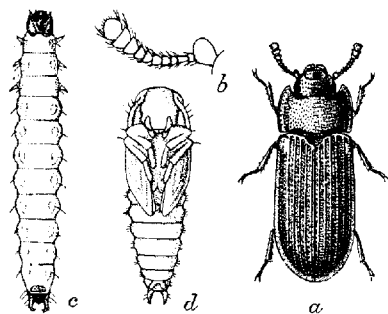


FIG. 2.—The Siamese grain beetle (*Lophocateres pusillus*): a, Adult or beetle; b, antenna of same; c, larva; d, pupa. a, c, d, About ten times natural size; b, greatly enlarged. (Original.)

November 30, 1904, this bureau received from Mr. D. S. Bliss, Bureau of Plant Industry, a bag of paddy rice-heads from Java in which this species was living. Many of the kernels showed where the beetles had escaped.

August 10, 1905, Mr. D. A. Brodie, also of the Bureau of Plant Industry, sent specimens in rice from a rice mill at Charleston, S. C., where the insect was associated with the common *Tribolium navale* Fab. and *Læmophloeus minutus* Oliv. and was evidently established. During the same month Mr. Samuel G. Stoney, Charleston,

S. C., sent specimens of this species, and in a letter of August 22 reported that millers in that vicinity had some years previously received rice from Siam and other points in the Orient as well as from Honduras.

It was reported, October 20, 1906, from El Rancho, Guatemala, by Mr. E. E. Knight, who furnished living specimens, as injuring grain, together with the so-called corn weevil (*Calandra oryza* L.). Living examples also occurred among some infested black beans.

During 1909 the species came under observation on several occasions, especially in different localities in Texas, the records being furnished chiefly by Mr. D. K. McMillan. June 26 of that year specimens were obtained in various materials from a flour mill in Galveston. June 28, Mr. J. G. Sanders, then of this bureau, found adults in eggplant and gourd seeds, and beans from Siam. Of its occurrence at Brownsville, Tex., Mr. McMillan wrote that the beetles were very abundant in old rye from the bottom of a bin, and that they were scattered throughout the mill inspected. He observed that they were much more sluggish than most mill insects, and clung closely to the flour sacks and to wood and paper upon which they were resting. They also have the habit of accumulating, or crowding, into small groups, thus showing the gregarious habit common to most herbivorous insects found in stored material. At one mill it was the most abundant species found among rubbish. October 25, Mr. F. A. Stockdale sent this species in paddy rice imported from India and riced to Georgetown, Demerara. December 6, Mr. McMillan sent specimens from Houston, Tex., where the insect occurred in rough Japan rice. At New Braunfels, Tex., it occurred in old rye, flour, and rubbish.

DESCRIPTION.

THE ADULT.

The genus *Lophocateres* was characterized in 1883 by Olliff, who referred it to the subfamily Peltini of the family Trogositidae, a group which includes the well-known genera *Peltis* and *Calitys*, beetles having flattened, more or less oval, bodies with much flattened thoracic and elytral margins. Olliff's description is as follows:

Genus *LOPHOCATERES* Olliff.

Head nearly quadrate. Eyes rather small, lateral, not prominent. Antennae 1-jointed, basal joint large, with the inner angle much produced, 2nd joint short, 3rd rather longer, 4th to 7th transverse and very short, last four forming a gradually elongated club, of which the joints increase in breadth as they approach the apex. Mandibles robust, inner margin straight, the apex slightly incurved. Maxillae with both lobes arrow and sharply jointed, the inner much the shorter. Maxillary palpi 3-jointed, the basal very small, the 2nd rather longer, the 3rd longer than the 1st and 2nd together, rounded at the apex. Labium with the anterior margin rounded. Labial palpi 4-jointed, of which the apical is somewhat the longer. Prothorax transversely quad-

rate, rather strongly margined laterally. Elytra about the same width as the prothorax, depressed, covering the abdomen, subparallel, with fine costæ. Legs short and slender; tibiae armed on their outer margins with short, sharp spines, the posterior tibiae with a row of blunt teeth at the base, slightly projecting over the 1st joint of the tarsus, tibial spurs short; tarsi 5-jointed, the basal very short, the 2nd and 3rd rather longer, the 4th shorter, and the 5th nearly as long as the other four together; claws simple.

The fine but distinct costæ on the elytra, the gradual 4-jointed club of the antennæ, and the peculiar structure of the posterior tibiae, are characters which will serve at once to distinguish this genus.

The antennæ in the present species (fig. 2, *a, b*) have the basal joint much enlarged and produced on the inner surface, the terminal joints forming a three-jointed club instead of a four-jointed one as is in the type species. The strongly produced apices of the thoracic margin form a strong character, common to the group, but not found in other forms of beetles known to attack stored cereals.

Klug's original description of the species is as follows:

PELTIS P.

81. *Peltis pusilla* n. sp.

P. elongata, ferruginea, capite thoraceque punctatis, elytris punctato-striatis. Long. lin. 1½.

Statura fere *P. oblonga*. Depressa, fere linearis, dorso ferruginea, subtilius rufo-testacea. Caput et thorax confertim punctata. Elytra thorace duplo-longiora, marginata, striata, ad strias punctata. Pedes rufo-testacei.

The species may be further recognized by the following description:

Lophocateres pusillus Klug.

Elongate, flattened; dorsal surface glabrous, ferruginous brown, with elytral margins paler ferruginous, strongly punctate. Head deeply, closely, and coarsely punctate. Thorax transverse, finely and distinctly punctate like the head, sides subparallel, narrowed anteriorly. Elytra parallel, each presenting seven costæ which bear on each side a row of close and deep punctures. Apices of elytra rounded. Legs ferruginous.

Length 2.7-3 mm.; width 1.0-1.2 mm.

THE LARVA.

M. Claudius Rey* gives a description of the larva (fig. 2, *c*), of which the following is a translation:

Body subelongate or oblong, somewhat attenuate at the extremities, subdepressed or a little convex, obsolete pilose at the edges; dirty white, somewhat shiny, with the head and last abdominal segment fulvous, the latter armed at the apex with an angular median tooth, and with two strong hooks with points recurved upward and slightly toward each other.

Head nearly round, a little narrower than the prothorax, somewhat divided by a median channel into two smooth and somewhat convex discs, flattened, bimpressed and subrugulose in front, decided fulvous yellow, provided on the sides with four or five long, pale bristles. Labrum transverse, ruddy. Mandibles ferruginous, with black points, bidentate. Palpi small, testaceous; eyes rather distinct; antennæ slightly projecting, testaceous, the joints narrowing gradually.

Prothorax in the shape of a transverse rectangle somewhat out of proportion, pale and shiny. Mesothorax and metathorax transverse, wider than the prothorax but both together hardly exceeding it in length. Pale, more or less unequal, the sides somewhat curved.

Abdomen more or less enlarged, somewhat rounded at the sides of segments, and narrowing to the rear. Of the nine segments, the first eight are shining dirty-white, short, more or less uneven, folded transversely and surmounted by four longitudinal rows of swellings or scars, the lateral rows of which are less pronounced. The ninth is a little narrower, provided on the back with a large flattened plate, which is received in a broad hollow on the eighth segment, fulvous, rugulose or folded transversely for about the first third, and broadly hollowed upon the summit, the deepest part of the hollow armed with a median angular or conical tooth, and limited by the two strong hooks, darker in color and with the points recurved upward and inward.

Beneath the body is pale, subdepressed, sparsely hairy, more or less uneven, with the underside of the head and the last ventral arch fulvous.

Feet short, pale, terminating in a small hard hook, almost straight, brownish.

Length 5.35 mm.; width 1.07 mm., of head 0.50 mm.

Measurements from fully mature, freshly killed specimens extended full length.

THE PUPA.

The pupa has not been described and no material is at present available for descriptive purposes. The general appearance of the pupa, however, is well shown in the accompanying illustration (fig. 2, d). In life it is of the same whitish color as the larva and like the larva, also, its last segment terminates in two processes, slightly incurved.

It measures about 2.7 mm. in length and 1 mm. in width.

DISTRIBUTION.

There is now practically no doubt that the species is firmly established in this country, both in North America and in South America, and that it is cosmopolitan in a somewhat narrow sense, apparently being restricted to the tropical and to the warmer temperate zones corresponding to the Lower Austral of North America.

Since this species was first observed by the writer in a Siamese grain exhibit, and as it appears to be well established there, it may be known as the Siamese grain beetle.

HABITS.

Writing of this species in 1888, M. Claudius Rey stated that he discovered the larvæ in company with the adults in a shipment of soy beans (*Soja hispida*), which were in most part reduced to powder, and which came from Saigon, Cochin China. He remarked that M. Valéry Mayet had collected the same species at Marseille, France, in peanuts, and that the beetle had been captured flying on the maritime coast where he surmised it would probably some day become

naturalized. He expressed the belief that the larva obtained its nourishment from animal substances or products after the supposed habits of other species of Trogositidae, basing this opinion on its resemblance to them in structure and to the attendant circumstances that the larvæ were not actually found in the seeds of these two plants.

Experiments conducted by the writer, on receipt of living material in 1903, show conclusively that this species will breed in stored grain. A small number of beetles were confined in a jar of uninfested wheat, corn, and meal in February, and in March of the following year, when examined, larvæ from these as well as living beetles and many dead ones were found. There is no evidence as yet of predaceous habits of this insect, as is the case with the related cadelle.

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